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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
09/414,526	10/08/99	KIM	Y SEC.637

EXAMINER	
CLEVELAND, M	
ART UNIT	**PAPER NUMBER**
1762	10

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DATE MAILED: 02/26/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary	Application No. 09/414,526	Applicant(s) Kim et al.
	Examiner Michael Cleveland	Group Art Unit 1762

☒ Responsive to communication(s) filed on *Dec 29, 2000*

☒ This action is **FINAL.**

☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire *3* month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claim

☒ Claim(s) *1-14* is/are pending in the applicat

Of the above, claim(s) *10 and 12-14* is/are withdrawn from consideration

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) *1-9 and 11* is/are rejected.

☐ Claim(s) _____ is/are objected to.

☐ Claims _____ are subject to restriction or election requirement.

Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☒ The proposed drawing correction, filed on *Dec 29, 2000* is ☒ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☒ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number) _____.

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☐ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). _____

☐ Interview Summary, PTO-413

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

DETAILED ACTION

Election/Restriction

1. Applicant's election of Group B in Paper No. 7 is acknowledged. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election has been treated as an election without traverse (MPEP § 818.03(a)). The elected group reads on claims 1-9 and 11. Claims 10 and 12-14 are withdrawn from consideration.

Drawings

2. The proposed drawing correction and/or the proposed substitute sheets of drawings, filed on 12/29/00 have been approved.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless --
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

4. Claims 1, 3-9 and 11 are rejected under 35 U.S.C. 102(e) as being anticipated by Comizzoli et al. (U.S. Patent 5,851,849, hereafter '849).

'849 teaches loading a substrate into a reaction chamber (col. 6, lines 25-27);

purging with nitrogen at a temperature of 150-200 degrees C (col. 6, lines 27-28) (Applicant states in the specification that the uniform termination is accomplished by purging the substrate with nitrogen at temperatures of 120-370 deg. C. Therefore, either the nitrogen purge

step of Comizzoli inherently achieves such uniform termination or else the termination results from essential features which are not present in the claims.);

injecting trimethyl aluminum (TMA) as a first reactant into the chamber (col. 6, lines 29-38) (The trimethyl aluminum must inherently chemically adsorb in order to bond the aluminum to the substrate. Also, some trimethyl aluminum remains non-adsorbed (col. 6, lines 37-38). Therefore, there must some positive pressure in the chamber, and some physisorption of the trimethyl aluminum must take place.);

purging the chamber with nitrogen to remove non-adsorbed TMA (col. 6, lines 36-41) (which removes physisorbed trimethyl aluminum); and

forming a solid thin film of aluminum oxide by injecting water vapor into the chamber to react with the TMA (col. 6, lines 38-40).

Claim 3: A final purge inherently removes the by-products and any intermediates of the reaction (col. 6, lines 40-41).

Claim 4: The initial nitrogen purge may last several seconds to an hour. 1000 s was used as a concrete example (col. 6, lines 27-29). Such a purge may be viewed as four purges of 250 s each.

Claim 5: Applicant's specification reveals that the initial nitrogen purge of '849 must inherently uniformly terminate the surface with N atoms.

Claim 6: Part of the passivated surface (i.e., 41 of Fig. 5) is silicon (col. 5, lines 8-65; Fig. 5).

Claims 7, 9, and 11: The reactants are TMA and water and react to form the single atomic oxide, alumina, as discussed above.

Claim 8: Applicant's Table 1 reveals that inherently the bonding energy between Si and N is greater than that between Si and C (an atom from the methyl ligands of TMA).

Claims 1, 3-6, and 8: Other passivating films than alumina may be formed by similar methods using a metal or silicon precursor and a nitrogen-containing compound to form nitrides (col. 7, lines 34-42).

5. Claims 1, 3, 6-7, 9, and 11 are rejected under 35 U.S.C. 102(b) as being anticipated by Kim et al. (Appl. Phys. Lett., **71**, pp. 3604-3606, hereafter Kim).

Claims 1, 6-7, 9, and 11: Kim teaches loading a silicon substrate into a reaction chamber,

cleaning to uniformly terminate the surface with atomic hydrogen,

dosing with TMA, which inherently chemisorbs to the surface,

purging with TMA, which inherently removes any physisorbed TMA,

and injecting water to react with the TMA to form an alumina film (p. 3604).

Claim 3: A final purge inherently removes the by-products and any intermediates of the reaction (p. 3604, col. 2).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 1, 3, 6-9, and 11 are rejected under 35 U.S.C. 102(b) as being unpatentable over Kim et al. (Appl. Phys. Lett., **71**, pp. 3604-3606, hereafter Kim) in view of Marcus et al. (U.S. Patent 5,169,579, hereafter '579).

Kim is discussed above. It does not teach uniformly terminating the surface bonds with atoms intended as major components of the film (e.g., oxygen).

'579 teaches that a surface may be prepared for subsequent film growth (See col. 3, lines 39-68) by modifying the surface to terminate in bonds to either hydrogen or oxygen (col. 7, lines 23-39). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have initially uniformly terminated the surface of the silicon substrate of Kim with oxygen instead of hydrogen with the expectation of similar results.

Claim 8: Applicant's Table 1 reveals that inherently the bonding energy between Si and O is greater than that between Si and C (an atom from the methyl ligands of TMA).

8. Claims 1-9 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kim in view of '849.

Claims 1, 3, 5-7, 9, and 11: Kim teaches the steps described above, but does not teach an initial purge step or uniformly terminating the surface with an atom such as nitrogen.

'849 teaches that an ALD chamber may be purged with nitrogen before the ALD process of depositing alumina, as described above. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have used such an initial nitrogen purge in the process of Kim to have removed potential contaminants from the reaction chamber before the

ALD process. Such a nitrogen treatment would inherently have terminated the silicon substrate with nitrogen atoms, as described by Applicant's specification.

Claim 2: Kim teaches that the substrate may be cleaned of a native oxide before being loaded into the chamber, but does not explicitly state that the cleaning step comes before loading the substrate into the chamber. However, it appears that it would have been obvious to one of ordinary skill in the art at the time the invention was made to have provided the cleaning step before loading the substrate into the ALD chamber in order to avoid damage to and contaminants in the ALD chamber by the HF used in the cleaning process.

Claim 4: The initial nitrogen purge may last several seconds to an hour. 1000 s was used as a concrete example (col. 6, lines 27-29). Such a purge may be viewed as four purges of 250 s each.

Claim 8: Applicant's Table 1 reveals that inherently the bonding energy between Si and N is greater than that between Si and C (an atom from the methyl ligands of TMA).

Response to Arguments

9. Applicant's arguments filed 12/29/00 have been fully considered but they are not persuasive.

The Examiner recognizes Applicant's statements bridging pp. 4-5 that what is intended to be claimed is that the atom used to uniformly terminate the dangling surface bonds of the substrate is intended as a major component of the film. However, the claims do not require such. The claims only require that the atom used to terminate the surface bonds be a component of the solid film. Therefore, by arguing that the nitrogen of Comizzoli et al. or the hydrogen of Kim et al. contaminates the film, Applicant argues that the nitrogen or hydrogen does form part of the film, and thus meets the limitation of the claims. Accordingly, the rejections are maintained.

Even if Applicant amends the claims to affirmatively state the concept that the atom used to terminate the dangling surface bonds forms a major component of the film, the claims would not be patentable. 1) Comizzoli teaches such for at least nitrogen for the reasons given in the prior action and because Comizzoli teaches that nitride films may be formed in place of the alumina film via epitaxial methods (col. 7, lines 35-42). 2) The newly cited Marcus et al. teaches the equivalence of hydrogen-terminated and oxygen-terminated substrates for film growth. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have uniformly terminated the substrate bonds of Kim with oxygen instead of hydrogen with the expectation of similar results. Therefore, Applicant's arguments regarding the apparently intended claims are unconvincing in the absence of a showing of unexpected results.

Conclusion

10. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael Cleveland whose telephone number is (703)308-2331. The examiner can normally be reached on Monday-Friday from 8:30 a.m. to 4:00 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Shrive Beck, can be reached at (703) 308-2333.

Michael Cleveland
February 21, 2001

Shrive Beck
Supervisory Patent Examiner
Technology Center 1700